**SCENARIO**

You are an electrical technician in an electronics factory. Your supervisor asked you to work on solving some practical issues in different types of circuits that you are used in the products. Try to use your knowledge about circuit theory and transformation techniques to simplify and solve those problems.

**To achieve the assessment criteria for pass (P1.2 part 2/2) you must answer the following task:**

**Task 1:**

**A)**

**Antenna**

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Figure 1

The system shown in figure (1) is a colored TV receiving system produced at your factory. The antenna can be modeled as an impedance of **5 + j 5 Ω** and can receive a maximum of **100 mV RMS**.

**Your manager asked you to apply circuit theory technique; so that a maximum power can deliver to the TV for the following cases:**

1. TV with pure resistive load as the input impedance = **R.**
2. TV with complex input impedance **Z = R + j X**.

**B)**

Use both of analytical method and suitable software package to verify the superposition theorem in the circuit shown in figure (2). The frequency is 1 kHz

**{Your assessor will choose certain values for you}**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Vs1** | **Vs2** | **R1** | **R2** | **R3** | **C1** | **C2** | **L1** |
|  |  |  |  |  |  |  |  |



Figure (2)

**To achieve the assessment criteria for pass (P1.4 part 2/2) you must answer the following task:**

**Task 2:**

A band pass filter is a circuit used in many applications to pass certain frequency like in radio receiver. A band pass filter designed with parallel LR-C network as shown in figure (3).

1. Draw the circuit below in your simulator software.
2. **Your assessor will choose certain values for you**:

|  |  |  |
| --- | --- | --- |
| **R** | **L** | **C** |
| **50** Ω | 20 mH | 200 nF |
| **50** Ω | 2 mH | 2 µF |
| **50** Ω | 200 mH | 20 nF |
| **50** Ω | 0.2 mH | 20 µF |

1. Using your simulation software package the resonant frequency.
	* Put supply 50 V.
	* Change the frequency of the source from 500 Hz to 5 kHz (Step 250 Hz).
	* Measure the supply current each time.
	* Put your results into a table like:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **F** |  |  |  |  |
| **I** |  |  |  |  |

* + Plot I versus f, then according to this relation determine the fr.
1. Determine dynamic resistance.
2. Determine the quality factor.
3. Determine the band width.
4. Comment on the filter selectivity.



Figure (3)

**To achieve the assessment criteria for pass (P1.3) you must answer the following task:**

**Task 3:**

1. **Analyze the operation of a transformer as a magnetically coupled circuit.** The transformer has 500 primary turns and 100 secondary turns. The primary and the secondary resistances are 0.8Ω and 0.2 Ω respectively and the corresponding reactance is 2 Ω for the primary and 0.5 Ω for the secondary, then determine the equivalent:
* Resistance.
* Reactance.
* The equivalent impedance referred to the primary winding.
1. Two mutually coupled coils X and Y are connected in series as the following figure. Coil X has an inductance of 100 mH and 250 turns Coil Y has an inductance of 80 mH and 125 turns. At a certain instant after the circuit is connected, the current changing the flux by 10m WB in the second coil.
* Analyze the operation of this magnetically coupled circuit.
* Determine:
1. The mutual inductance between the coils.
2. The coefficient of coupling.

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**Figure (4)**

1. A mutual inductor is used to couple a 10 Ω resistive load to a 20 V generator as shown in the following figure. The supply frequency is 50 Hz. L1 = 0.5 H, L2 = 1 H and coupling coefficient = 0.8.
* Analyze the operation of the circuit.
* Simulate the circuit to find i1 and i2.

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**Figure (5)**

**To achieve the assessment criteria for Merit (M1.2) you must answer the following task:**

**Task 4:**

1. In the following circuit find:
* The current in 10mH coil.
* The voltage drop across 20Ω resistor.



Figure (6)

B) In the following circuit find:

* The current of each branch.
* The voltage drop across each component in the circuit.



Figure (7)

**To achieve the assessment criteria for Merit (M2.1) you must answer the following task:**

**Task 5:**

Show that the above circuit of task 4(B) can be solved by more than one theory.

**To achieve the assessment criteria for Distinction (D1.2) you must answer the following task:**

**Task 6:**

Simulate the circuit shown in task 4(B) and validate the results by comparing the simulated one by the calculated results in task 4(B).